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(54) Title: A PROCESS FOR THE DECONTAMINATION OF MEATS

(57) Abstract

Processes for reducing the microbial contamination of meat, poultry, fish and shellfish using solutions of ethylenediamine tetraacetic acid and an antimicrobial agent are disclosed. Processes for reducing the microbial contamination of wounds using ethylenediamine tetraacetic acid and an antimicrobial agent are also disclosed.

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A PROCESS FOR THE DECOMTAMINATION OF MEATS

This invention relates to a process for inhibiting or a combination thereof preventing the spoilage of meat, poultry, fish, shellfish and products thereof.

Current slaughter-dressing practices include a rapid succession of steps which include killing the animal, draining the blood, removing the integumentary covering and viscera, trimming off any obvious areas of fecal or visceral contamination, and refrigeration of the carcass. Due to the potential contamination of the carcass (meat and poultry) during the slaughter and dressing processes, better techniques for slaughter-dressing are being sought to reduce microbial contamination. Such improvements in decontamination of the meat and poultry are also sought to prolong the shelf-life of these food products. Techniques which are being studied include steam sterilization, treatment with lactic, acetic or citric acid, treatment with a bacteriocin, such as nisin, irradiation with ultraviolet light or ionizing radiation, and surface chlorination with hypochlorite or chorine dioxide. No method is completely successful in decontaminating animal carcasses.

In a similar manner, contamination of fish and shellfish by microorganisms occurs during storage and cleaning. Attempts to control the spoilage of fish and shellfish during storage or a combination thereof cleaning have focused on reducing the temperature of the fish and shellfish during storage.

It would therefore be advantageous to have a process for reducing the microbial contamination of meats and poultry, fish and shellfish during the storage and processing of such food products. It would also be advantageous to provide for a process whereby the microorganisms present on such food products are inhibited.

The present invention is to a process of decontaminating meat and poultry comprising contacting the meat or poultry with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent to remove or inhibit the growth of microorganisms on the meat or poultry.

In another aspect, the present invention is to a process of decontaminating fish or shellfish comprising contacting the fish or shellfish with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent to remove or inhibit the growth of microorganisms on the fish or shellfish.

In still another aspect, the present invention is to a process for reducing the microbial contamination of a wound comprising washing or irrigating the wound with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent either simultaneously or sequentially to remove or inhibit the growth of microorganisms.

It has been unexpectedly discovered that treatment of meat, poultry, fish or shellfish with a combination of ethylenediamine tetraacetic acid and an antimicrobial agent reduces the amount of microbial contamination to a much greater extent than the use of a solution of either alone.

The processes of the present invention provide for reducing the number of microorganisms present on meat, poultry, fish and shellfish during processing or storage of these food products. The process comprises contacting the food product with a solution of ethylenediamine tetraacetic acid and an antimicrobial agent. As used herein the term "microorganism" refers to bacteria, yeast, and fungi. The term "antimicrobial", as used herein means a bacteriocide or bacteriostat and includes the use of a mixture of antimicrobial compounds. The term ethylenediamine tetraacetic acid (EDTA) as

used herein includes the acid, salts of EDTA, calcium or magnesium chelates of EDTA, or mixtures thereof.

The EDTA for use in the present invention is readily available from a number of commercial sources, such as EDTA sold under the Trademark VERSENE™, a Trademark of The Dow Chemical Company.

Antimicrobials for use in the processes of the present invention are those which are safe for human consumption and generally do not adversely affect the flavor of food products. Examples of antimicrobials for use in the present invention, referred to herein also as antimicrobial agents or antimicrobial compounds, are those listed in Kirk Othmar Encyclopedia of Chemical Technology (fourth edition), under the headings food additives and classes of antimicrobial compounds, the disclosure of which is incorporated herein by reference. Other antimicrobial compounds which can be used in the process of the present invention are those listed in U.S. Patents 5,320,829 and 5,286,479, the disclosures of which are incorporated herein by reference.

In general the preferred antimicrobial agents are organic acids and classes thereof, cationic antimicrobial compounds such as quaternary ammonium compounds, iodine or iodine releasing compounds and biguanides. Examples of organic acids include lactic acid, acetic acid, citric acid, succinic acid, glutanic acid, phosphonic acid, cinnamic acid, derivatives of cinnamic acid such as substitutions on the aromatic ring and glycolic acid.

Examples of the succinic acid class include ethylenediamine disuccinic acid (EDDS), 2-hydroxypropylenediamine dicuccinic acid and any salts thereof and mixtures thereof. A preferred example of the glutaric acid class is ethylenediamine diglutaric acid or salt thereof.

Examples of the phosphonic acid class include ethylenediaminetetrakis (methylene phosphonic acid), diethylene triamine pent (methylene phosphonic acid), ethylene diamine tri (methylene phosphonic acid), hexamethylene diamine tetra (methylene phosphonic acid), methylene diphosphonic acid, hyroxy 1,1-hexylidene diphosphonic acid, vinylidene 1,1 diphosphonic acid, 1,2 dihydroxyethane 1,1 diphosphonic acid, alpha-hydroxy-1 phenyl ethyl diphosphonic acid and hydroxy-ethane-1,1-diphosphonic acid and salts thereof and mixtures thereof.

Cationic antimicrobial agent refers to an organic amine where the nitrogen is capable of being positively charged in an aqueous environment. Preferred cationic antimicrobial agents are those listed in U.S. Patent 5,286,479. Preferred quaternary ammonium compounds include dodecyl trimethyl ammonium bromide, benzyl dimethyl stearyl ammonium chloride, N-tetradecyl-4-ethylpyridinium chloride and cetylpyridinium chloride.

Biguanides for use in the present invention include chlorhexidine, N'-(4-chlorobenzyl)-N^5-(2,4-dichlorobenzyl)biguanide; p-chlorophenyl biguanide; 4-chlorobenzylhydrylbiguanide; N-3-lauroxypropyl-N^5-p-chlorobenzylbiguanide; 5,6-dichloro-2-guanidinobenzimidazole; N'-p-chlorophenyl-N^5-laurylbiguanide, and their non-toxic acid addition salts.

The antimicrobial compounds for use in the processes of the present invention are commercially available or may be obtained by those of ordinary skill in the art without undue experimentation using common synthetic routes disclosed in the art.

The contacting of the EDTA and antimicrobial agents in the process of the present inventions includes application of the EDTA and antimicrobial agents to the food products by spraying,

dipping the food products in solutions of these compounds or placing the food products in a bath containing EDTA or a combination thereof an antimicrobial agent. In the processes of the present invention, the EDTA and antimicrobial agent can be present in one solution and thus the food product is exposed to both the EDTA and antimicrobial agent in one step. In an alternative procedure, the food product can be contacted with the EDTA and antimicrobial agent in two successive steps, for example, spraying a carcass with a solution of EDTA followed by spraying the carcass with an antimicrobial agent.

By effective amount it is meant that the EDTA and antimicrobial concentrations are more effective in removing microorganisms from the meat, poultry, fish or shellfish than the use of water alone during the washing process or at a concentration so that a sufficient amount of EDTA and antimicrobial agent adheres to the food product to prevent or inhibit the growth or metabolism of a microorganism.

The concentration and pH of EDTA solutions for use in the present invention is adjusted for optimal effect in removal of microorganism from the meat or poultry. The pH of the EDTA solution is generally between about pH 3 and pH 9 to produce maximal removal of bacterial lipopolysaccharide. The preferred pH of the EDTA solution is between about 6 and 8.5. The concentration of the EDTA can be adjusted and will be dependent on the expected microbial load in the process and can be optimized for each slaughter house. Generally the EDTA used will be between about 0.001 and about 0.3 molar. Preferably the concentration of the EDTA is between about 0.005 and about 0.20 molar. More preferably the concentration of the EDTA is between about 0.05 and about 0.10 molar. The temperature at which the solution of EDTA is used is generally between 0 and 40 degrees Centigrade.

The concentration of the antimicrobial compound will depend upon the effectiveness of the particular compound and is

generally between 0.001 and about 2 molar. Preferably the concentration of the antimicrobial compound is between about 0.005 and about 1 molar. More preferably the concentration is between 0.005 and 0.5 molar.

The vehicle or carrier for making the EDTA and antimicrobial solutions is generally any vehicle in which the respective agents are soluble and which is safe for human consumption. Preferably the EDTA and antimicrobial agents are solution with water as the carrier.

When applying the EDTA and antimicrobial compound as a spray or wash, the amount and duration of the spray is generally sufficient to remove all the observable fecal contamination and to wet all observable surfaces. When doing successive steps of applying the EDTA and antimicrobial compound, it is preferred that all the observable fecal contamination is removed in the first step and subsequently the exposed surfaces are wetted with the EDTA or antimicrobial compound in the second or subsequent steps.

When the EDTA and antimicrobial are used in a dip or bath, either in combination or in successive steps, the duration of the washing will depend upon the specific meat and the slaughter house. For example, the time to place a poultry carcass in a dip and removal will generally be shorter than the time necessary to place and remove a beef carcass from such a dip. Generally the time for such washing will be between about 0.05 and about 10 minutes.

EDTA and antimicrobial compound are preferably contacted with the meat or poultry after removal of the skin or hide and the removal of the viscera. In slaughter house operations, this contacting is preferably done within 15 minutes of the death of the animal. For slaughter house operations, the EDTA and antimicrobial compound are preferably contacted with the meat or poultry by spraying.

For fish and shellfish, the EDTA and antimicrobial compounds are preferably applied at the time of removal from the water. For fish, there could be multiple applications, for example, upon removal from the water and again during the cleaning process. The concentration and temperature of application of the EDTA and antimicrobial compounds are as those specified above for meat and poultry.

In the process of cleaning or irrigating of open wounds, the EDTA and antimicrobial compounds at the temperature and concentrations specified above can be applied to the wound using standard procedures in the art.

The invention will be further clarified by a consideration of the following examples, which are intended to be purely exemplary of the present invention.

Examples

Example 1. Upon pulling in the nets on a shrimp boat, the shrimp were immediately placed in a tank containing an aqueous solution of 0.05 molar EDTA and 0.03 g% cetylpyridinium chloride at pH 8 and 10 degrees Celsius. They were maintained in this solution until delivery to the processing plant.

Example 2. At a beef processing plant, a cow was killed and hung by the hind legs to drain the blood from the neck. The hide was removed and the animal was eviscerated. Some fecal contamination occurs during the evisceration process and the visible fecal contamination was removed by trimming. Immediately following the trimming and within 8 minutes from the time evisceration of the animal began, the carcass was sprayed with a 0.05 molar aqueous solution of EDTA at pH 7 and temperature 37 degrees Celsius for 30 seconds so that every surface of the carcass was thoroughly flushed with the solution. The carcass was then immediately sprayed for 30

seconds so that every surface was thoroughly flushed with a solution of 5 weight percent citric acid at a temperature of 37 degrees Celsius. The carcass was then moved into a freezer.

Example 3. At a beef processing plant, a cow was killed and hung by the hind legs to drain the blood from the neck. The hide was removed and the animal was eviscerated. Some fecal contamination occurs during the evisceration process and the visible fecal contamination was removed by trimming. Immediately following the trimming and within 8 minutes from the time evisceration of the animal began, the carcass was sprayed with a 0.05 molar aqueous solution of EDTA and 5 weight percent sorbic acid at a temperature of 37 degrees Celsius and a pH of 6.5 for 30 seconds at such a flow rate that all the surfaces of the carcass were thoroughly flushed with the solution. The carcass was then moved into a freezer.

Example 4. Upon pulling up the nets upon a fishing vessel, the fish were immediately placed in a tank containing an aqueous solution of 0.03 molar EDTA and 1 weight percent acetic acid at pH 6.5 and 5 degrees Celsius. The fish were maintained in this solution until delivery to a processing plant. At the processing plant, the fish were descaled and gutted. Immediately after the gutting procedure, the fish were dipped in a bath of 0.1 molar EDTA solution at pH 7 with adequate agitation to rinse all surfaces of the fish. The fish were then dipped in a bath of 3 weight percent citric acid with adequate agitation to rinse all surfaces of the fish.

Example 5. A chicken was entered into a slaughter-dressing plant where it was killed, drained of blood, and scalded to remove the feathers. The chicken was eviscerated. Immediately following the evisceration, all surfaces of the chicken were rinsed with an aqueous solution of 0.1 molar EDTA solution at pH 7 and 37 degrees Celsius for 30 seconds. The chicken was then rinsed with a 0.2 weight percent solution of sorbic acid

at 37 degrees Celsius and pH 7 so that all surfaces were thoroughly wetted

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being indicated by the following claims.

CLAIMS

1. A process of decontaminating meat and poultry comprising contacting the meat or poultry with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent to inhibit the growth of microorganisms on the meat.

2. The process of Claim 1 wherein the solutions are contacted with the meat or poultry during the slaughter-dressing process.

3. The process of Claim 2 wherein the solutions are contacted with the meat or poultry by means of spraying, bath or a dip.

4. The process of Claim 1 wherein the ethylenediamine tetraacetic acid and the antimicrobial agent are contacted with the meat or poultry in two or more successive stages.

5. The process of Claim 4 wherein the solution of ethylenediamine tetraacetic acid is contacted the meat or poultry in one stage and the antimicrobial solution is contacted with the meat or poultry in a separate stage.

6. The process of Claim 5 wherein the solution of ethylenediamine tetraacetic acid is contacted with the meat or poultry prior to contacting the meat with the antimicrobial solution.

7. The process of Claim 1 wherein the antimicrobial is a solution of an organic acid, a solution of a quaternary ammonium compound, a solution of iodine or an iodine releasing agent, or a biguanide.

8. The process of Claim 7 wherein the concentration of the antimicrobial is between about 0.001 molar and about 2.0 molar.

9. The process of Claim 1 wherein the concentration of the ethylenediamine tetraacetic acid is about 0.001 to about 0.30 molar.

10. A process of decontaminating fish or shellfish comprising contacting the fish or shellfish with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent to inhibit the growth of microorganisms on the fish or shellfish.

11. The process of Claim 10 wherein the solutions are contacted with the fish or shellfish during storage of the fish or shellfish.

12. The process of Claim 10 wherein the fish is contacted with the ethylenediamine tetraacetic acid and antimicrobial agent solutions during processing.

13. The process of Claim 10 wherein the solutions are contacted with the fish or shellfish by means of spraying, bath or a dip.

14. The process of Claim 10 wherein the ethylenediamine tetraacetic acid and the antimicrobial agent are contacted with the fish or shellfish in two or more successive stages.

15. The process of Claim 14 wherein the solution of ethylenediamine tetraacetic acid is contacted with the fish or shellfish in one stage and the antimicrobial solution is contacted with the fish or shellfish in a separate stage.

16. The process of Claim 15 wherein the solution of ethylenediamine tetraacetic acid is contacted with the fish or shellfish prior to contacting the fish or shellfish with the antimicrobial solution.

17. The process of Claim 10 wherein the antimicrobial agent is a solution of an organic acid, a solution of a quaternary

ammonium compound, a solution of iodine or an iodine releasing agent, or a biguanide.

18. The process of Claim 17 wherein the concentration of the antimicrobial agent is between about 0.001 molar and about 2.0 molar.

19. The process of Claim 10 wherein the concentration of the ethylenediamine tetraacetic acid is about 0.001 to about 0.30 molar.

20. A process for reducing the microbial contamination of a wound comprising washing or irrigating the wound with an effective amount of a solution of ethylenediamine tetraacetic acid and a solution of an antimicrobial agent either simultaneously or sequentially to inhibit the growth of microorganisms.